MGB GT gear change issues – photos at the end of this article

<u>Introduction</u>

In 2018 a decision was made to have the engine reconditioned for my MGB GT. Whilst the engine was out a number of other upgrades and refurbishments were undertaken. In particular it was decided to fit a Ford Type 9 gearbox in place of the standard 4 speed and overdrive gearbox. This particular decision was taken because there was one available at no additional cost (as it had been assembled for another vehicle and never used), and the existing overdrive switching was becoming problematical with oil leaks from the usual places. Prior to the engine reconditioning and fitting of the alternative gearbox it did not appear to be necessary to fully depress the clutch pedal to achieve a smooth unimpeded gear change.

<u>The Problem</u>

After re fitting the engine and gearbox in 2019 it was noted that there were two problems or unexpected consequences. First changing from 1st gear to 2nd gear and at times selecting others (particularly 3rd) was difficult and more difficult at some times than others. Secondly, it appeared that full travel of the clutch pedal was required for every change i.e. the pedal needed to be pressed to the carpet in order to achieve the least difficult gear change. Previously as expressed above with the OEM gearbox it had been possible to change gear with less than full travel of the clutch pedal. It also required greater pedal pressure to operate the new clutch. (Later it became known that the engine builder had fitted a heavy duty clutch ~ presumably to ensure that there were no issues as a consequences of uprating the engine even as small as these improvements were). The fitting of the heavy duty clutch explained the greater operational pedal load (a probable increase in pedal load of around 15% might be expected based on an alternative similar clutch system) but not the need to fully depress the clutch pedal. The additional necessary pedal load possibly gave rise to some fluid passing the pressure seal in the master cylinder that didn't help the situation.

What follows is a report on a series of unexpected failures and investigations to explain or better understand why full pedal travel was necessary for every gear change. Following each failure and subsequent remedy the situation improved.

<u>First failure</u>

Whilst out on a club run in late 2021 it became clear that the hydraulics were failing and that master cylinder seal failure was the obvious source of the problem. Consequently the master cylinder was renewed and an immediate improvement was observed and all changes became easier but not entirely overcoming the difficulties in changing between 1st and 2nd. However, it was still necessary for full pedal travel in order to change gear compared to the feeling or experience with the OEM gearbox in place. This master cylinder change was completed in Oct 2021 (together with slave cylinder and clutch hose changes).

<u>Second failure</u>

Early in 2022 whilst getting the car out of the garage it was noticed that there was little resistance in the pedal pressure, further checks revealed total loss of fluid in the reservoir and fluid beneath clutch and brake master cylinders. Subsequent investigation suggested that the "o" ring seal between the reservoir and master cylinder body had leaked fluid out "over winter" due to a small defect in the plastic body of the reservoir at "just the right place". It is not believed that there was a leak at the copper joints at the union between master cylinder and pipework as this had been tested after fitting by leaving a paper towel in place to catch any leaks during operation and there were none.

Consequently the master cylinder was renewed for a second time and the system re-bled. Operationally it all worked without issue apart from the improving but continuing minor impediment in selecting second gear and at times 1^{st} gear. This impediment is best summarised as follows. When selecting second gear one could feel that the synchromesh had established the position to complete the gearchange but required more force to pull the gearstick back to complete the gearchange than was experienced when changing between 3^{rd},4^{th}, or 5^{th}.

Third failure

A few weeks later (May 2022) when out on a lengthy club run there was an occasional sensation that there was a "screech" from the clutch release bearing. This was faint and caused no real anxiety. A day or so later when taking part in a much longer run the "screeches" became a little more frequent and occasionally some low level vibration could be felt through the pedal when changing gear. After finishing the run and setting out on our way home after "taking a cream tea" the vibrations from the clutch pedal and the accompanying screech were more than concerning. It was clear that the release bearing was failing if not failed.

Engine out

There was some hope that the Type 9 gearbox could be removed without taking the engine out. This proved to be impossible so both engine and gearbox were removed "as one" and then the gearbox parted from the engine. On inspection it was observed that the carbon release bearing had worn down into its housing by about 1 to 2mm with a convex profile. The contact point on the clutch itself was also worn with a corresponding concave profile. The release bearing had failed within approximately 3000 miles. Factors that possibly contributed to an early failure were a stronger slave cylinder return spring, a longer than standard slave push rod, the natural stiffness of the new rubber release arm gaiter, and the additional force needed to operate the heavy duty clutch.

As the gearbox was out of the car it was sent for assessment to a reputable specialist. On first examination it was demonstrated that the fulcrum position for the original Ford gearstick and the item supplied in the conversion kit were different and that with the Ford item much less effort was required to change gear (when tested on the bench) than with the item supplied in the kit. When the gearbox was assembled for the first time (around 2015) after modifying the 1^{st} gear ratio to a "long first" a selection of aftermarket synchro rings were fitted. These rings may not have been manufactured with the exact same metal composition as was first used by Ford and possibly not to the same physical dimensions or detail. In operation they may have performed differently to the Ford OEM items ~ we will never know the answer to that. However, the gearbox was reassembled (July 2022) with OEM Ford items from the specialist's stock. Trial movement of the gearstick prior to use and subsequent road use following the gearbox service does suggest that movement between gears is now much better although still with greater resistance than expected. That difference is probably due to the different fulcrum configuration.

A significant time was taken to establish more about the clutch fitted during the engine reconditioning process. Researching the MGOC forum pages and contact with MGOC technical suggested that the particular model of clutch cover fitted during engine rebuild had in the past been the cause of a number of failures. It was also established that a like for like replacement was available from one supplier's "old stock" but it was no longer available from the manufacturer. Contact with the manufacturer in an attempt to establish if these potential failures had been overcome proved to be impossible as the company failed to respond. However, contact with the company that marketed and sold alternative clutch components under the Borg and Beck name was much more satisfactory. Furthermore it was confirmed that the clutch that they were marketing for the MGB was capable in transmitting the power and torque of the reconditioned engine using the standard arrangement. There was a strong recommendation to deploy what they referred to as the "heavy duty" version as in service the roller system is better for today's service factors. In that specification the only difference is the use of a roller release bearing rather than a carbon release bearing where clutch cover and friction plate are identical in both cases. As the clutch removed had been fitted with a larger diameter friction plate without any known issue it seemed appropriate to fit a similarly sized item for various reasons including the fact that it would match any minor grooving on the fly wheel. The item identified and selected is believed to have been developed for the TR7 5 speed arrangement.

Operational factors and investigations

As there were available 3 clutch master cylinders (one of the "metal can" variety removed from a 1972 MGB some years previously, the item that failed in Oct 2021, and the item that failed in early 2022) it was decided to determine what if anything affected the operational differences between these three items, and the apparent requirement to deploy maximum pedal travel to affect a smooth gear change.

The three master cylinders were dismantled for inspection. Various measurements were taken to establish the maximum possible master cylinder stroke and subsequently the maximum possible slave cylinder stroke. Clearly some of the methods used to identify the relevant details are prone to error (and could not be supported in any court of law) as can be seen in the images shown below. However, they are in the opinion of the writer good enough to give an acceptable answer, and those obtained do cross correlate and confirm that the dimensions obtained are "fit for purpose".

In summary and leaving out the how this was done it is concluded that the maximum pedal stroke possible for each of the three items was for all practical purposes the same (although if the metal can item had a longer pushrod the fluid displacement when the pedal reached the carpet would have been greater due to the body of the casting having a greater depth than the other two items). By calculation it was established that the volume of fluid displaced in the master cylinder when deploying maximum pedal travel translated into a maximum theoretical slave cylinder stroke of 9.72mm (based on piston diameters of master and slave). There would be some loss until the lip seal in the master cylinder passed the expansion hole in the master cylinder.

The use of a heavy duty clutch assembly needs greater pedal force to operate it (regardless of the type of release bearing) and therefore requires a master cylinder in optimum condition to ensure that there is no leakage past the pressure seal or there will be loss of slave piston travel. Secondly the use of an aftermarket slave cylinder that deploys a stronger pressure retaining spring (and they do seem to vary) places additional load on any carbon release bearing particularly if using a longer slave push rod.

Once the gearbox had been removed from the engine and the operational release fork removed for examination and fitted with a new bush it was seen that the theoretical maximum stroke of the slave cylinder (9.72mm) translated into a theoretical maximum movement at the release bearing of

8.5mm. As mentioned above and bearing in mind the potential for error in measurements and the need to pass the expansion hole in the master cylinder it can be easily seen that this dimension ties up well with a required operational figure of 8mm (quoted by a reliable source) for full release of the clutch.

Conclusion

For full "release" travel with the standard clutch, master cylinder, and slave cylinder it is necessary to fully depress the clutch pedal i.e. as far as it will go into the carpet ~ if fitted. It is therefore assumed, as the relative components are no longer available, that the items removed from the vehicle when the engine was reconditioned were significantly worn. Or a partial release (possibly due to the OEM clutch as opposed to the heavy duty item delivering greater clamping force) enabled some slip to occur that facilitated an uninterrupted gear change. The recent additional resistance to a gearchange is also a consequence of the aftermarket gear stick having a different fulcrum position when compared to that of a standard OEM Ford item.

Acknowledgements

- Throughout much of the initial investigations a great deal of help was received from a well known MGOC forum contributor ~ Paul Hunt. And it is thanks to him that the initial comparisons and measurements were made possible.
- MGOC forum contributors for various images and comments
- MGOC Technical

Below are a series of tables, images and sketches showing some of the components in the system and the relevant dimensions as established using the methods shown in the images below.

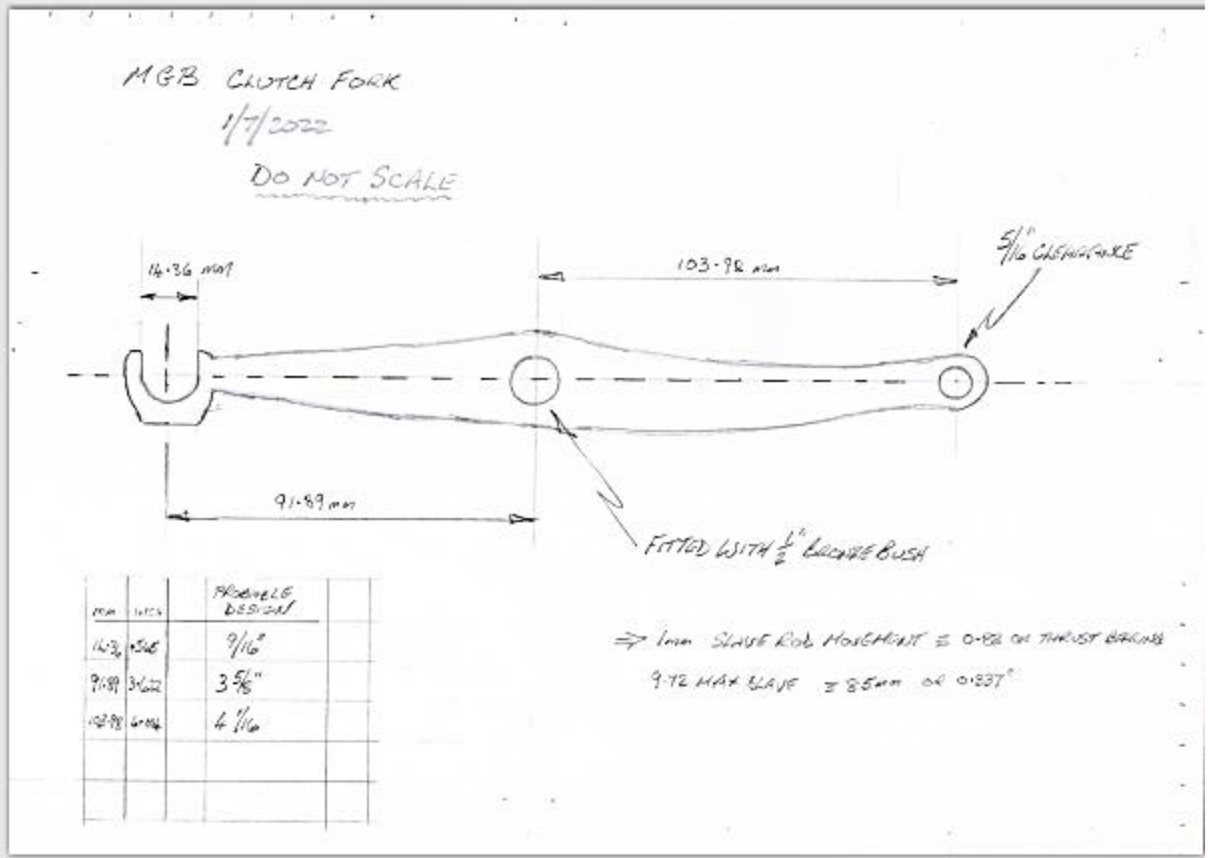
Maximum possible pedal movement without master cylinder in position	34mm	
Maximum pedal movement with master cylinder in position (master cylinder push rod stroke)	26.1 to 27mm	Varied depending on pressure applied by the driver as the carpet was crushed
Maximum possible piston stroke as determined by the master cylinder assembly as tested on the bench	26.5 to 27mm	Not a precise measurement as this varied depending on push rod "wobble" as the measurement was taken
Master cylinder return spring coil bound dimension	18.3 to 21 mm	This dimension is the best approximation possible and varied slightly as the coils collapsed together
Master cylinder depth (aftermarket)	120.1 mm	
Master cylinder depth (1972 metal can item)	125 mm	
Master cylinder return spring platform thickness	0.9 mm	
Master cylinder return spring free length (aftermarket)	74.1mm	Not recorded for OEM item but it was slightly different

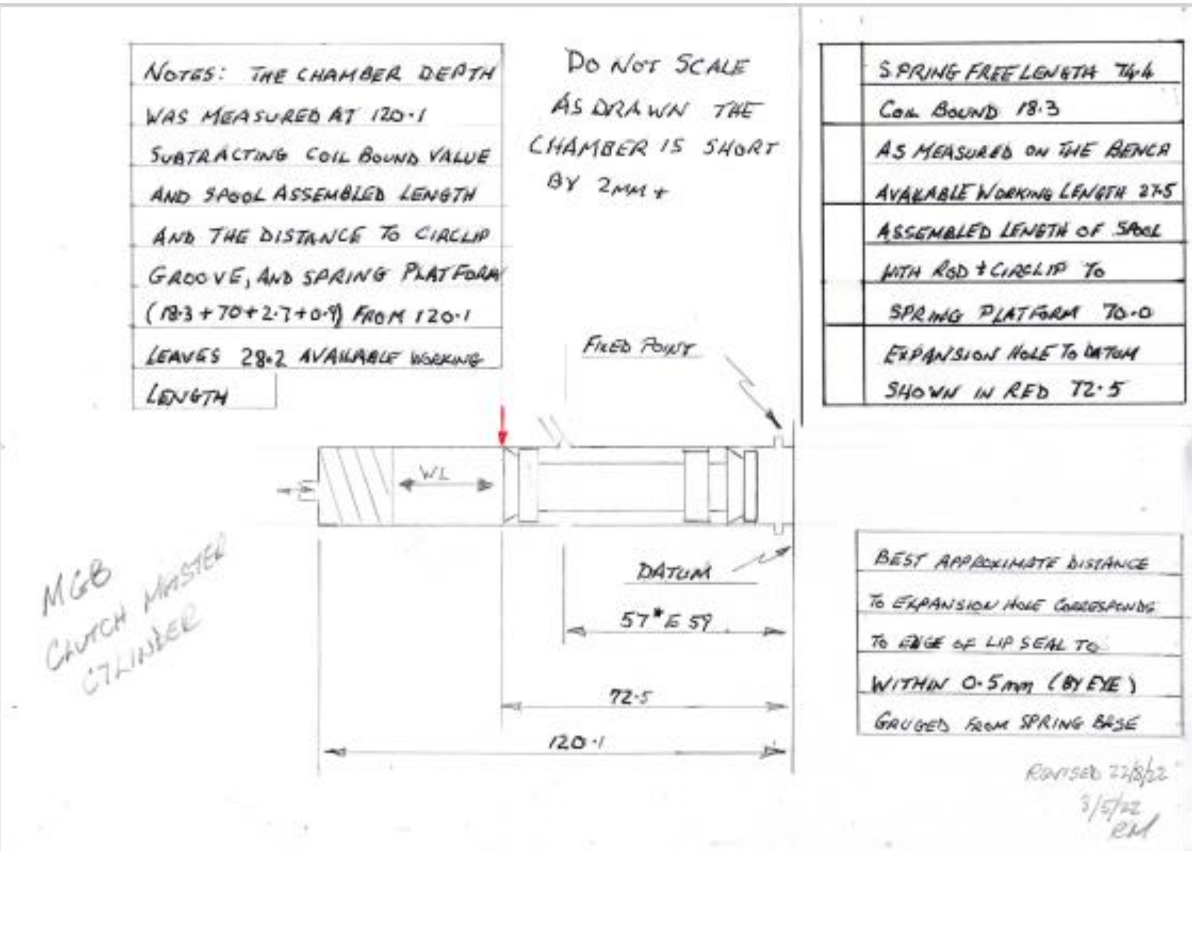
Master cylinder assembled spool length to circlip groove	70mm	Some error should be accepted here due to method of measurement ~ see images
Master cylinder ~ distance to expansion hole from datum	72.5mm	Best approximation gauged by eye and best practical means without sectioning the body. This would correlate reasonably with the assembled spool length, and some measurement error must be expected
Clutch fork lever arm external	103.98mm	As measured with best practical means available
Clutch fork lever arm internal	91.98mm	As measured with best practical means available

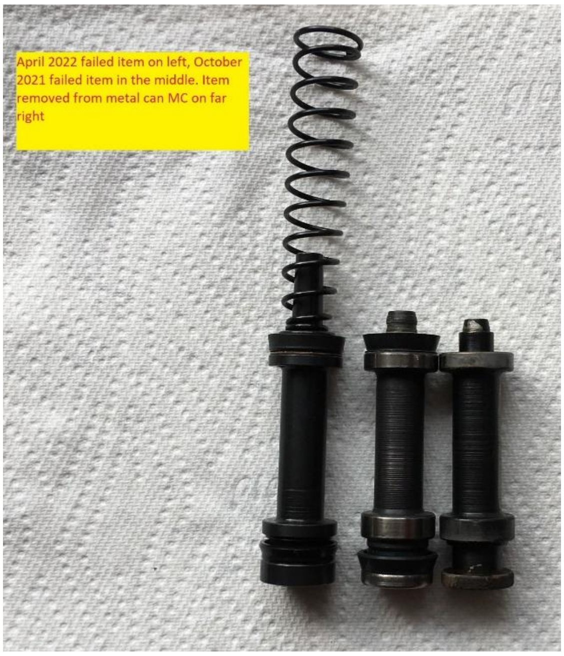
Comment.

1. Master cylinder bore is 0.75”, Slave Cylinder bore is 1.25” => that the displacement ratio is (0.75x0.75)/(1.25x1.25) or 0.36 :1.
2. The maximum possible Slave cylinder displacement with a 27mm master cylinder stroke would therefore be 9.72mm or 0.38”
3. The clutch fork ratio is equivalent to 0.88, and therefore a slave movement of 9.72mm would equate to a thrust bearing displacement of 8.5mm
4. The necessary operational figure of 8mm (quoted by a reliable source) for full release of the clutch equates well with the maximum calculated theoretical displacement of 8.5mm particularly when it is noted that some initial movement of the master cylinder piston is required to pass the expansion hole.
5. The two aftermarket master cylinder bodies had similar depths (120.1mm) whilst the 1972 metal can item was 5mm deeper at 125mm. It would therefore be reasonable to conclude that a greater stroke could be achieved with the “metal can” type (27+5 = 32 ~ close to the maximum pedal movement of 34mm) and that would offer a Slave cylinder stroke of 11.52mm or 0.45”. **<u>But</u>** that would require a very high pedal starting position and be associated with a different length of pushrod or possibly greater compression of the protective rubber boot. However, if all things were equal the greater potential fluid displacement would result in a greater displacement of the release bearing with potential different consequences for the clutch. The writer can’t comment on that.
6. It appears that the design intent was to require full pedal travel for optimum clutch release.

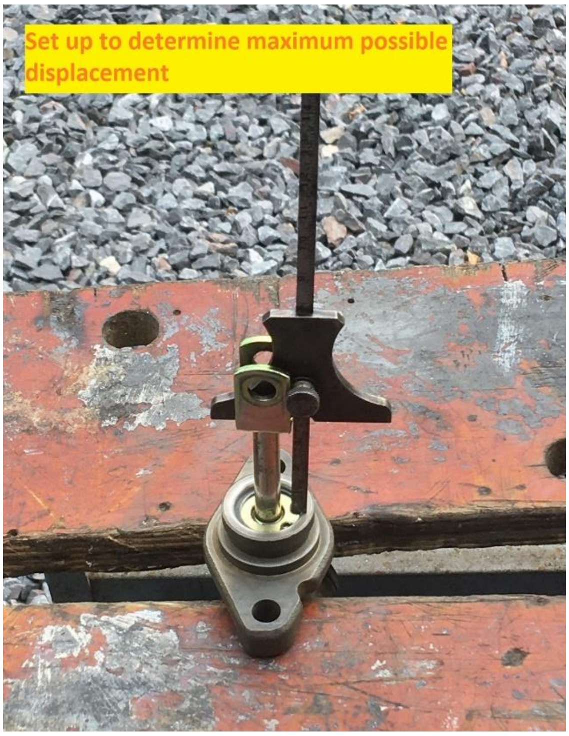
<u>Additional Observation</u> In the fitting instructions for the Ford Type 9 kit it is stated that when it comes to fitting the gearstick that “one screw may need to be tightened from below”. The writer can agree with that remark but found it easier to remove the large oval plate attached to the tunnel that is used to facilitate either manual or automatic gearchange (gearbox remote control cover HZA1431). The final screw can then be tightened from within the cockpit using an open-ended/ring spanner.


MGB CLUTCH FORK
1/7/2022
DO NOT SCALE
14.36 mm
103.98 mm
5/16" CLEARANCE
91.89 mm
FITTED WITH 1/2" BRONZE BUSH
PROBABLE DESIGN
14.36 .565 9/16"
91.89 3.622 3 5/8"
103.98 4.094 4 1/16
=> 1mm SLAVE ROD MOVEMENT ≡ 0.88 ON THRUST BEARING
9.72 MAX SLAVE ≡ 8.5mm OR 0.337"

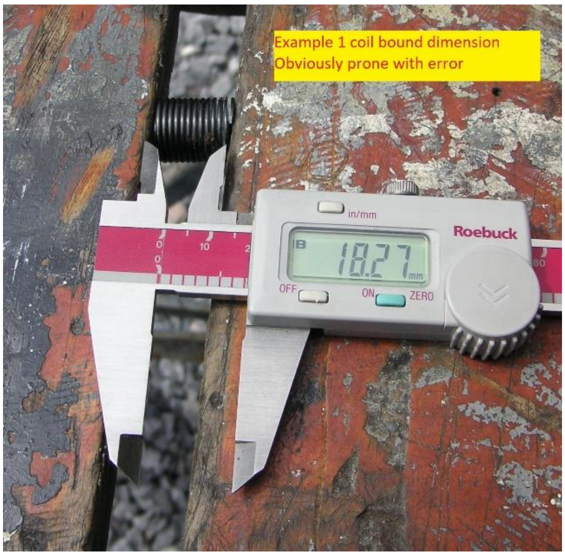

NOTES: THE CHAMBER DEPTH WAS MEASURED AT 120.1 SUBTRACTING COIL BOUND VALUE AND SPOOL ASSEMBLED LENGTH AND THE DISTANCE TO CIRCLIP GROOVE, AND SPRING PLATFORM (18.3 + 70 + 2.7 + 0.9) FROM 120.1 LEAVES 28.2 AVAILABLE WORKING LENGTH
DO NOT SCALE
AS DRAWN THE CHAMBER IS SHORT BY 2MM +
SPRING FREE LENGTH 74.4
COIL BOUND 18.3
AS MEASURED ON THE BENCH
AVAILABLE WORKING LENGTH 27.5
ASSEMBLED LENGTH OF SPOOL WITH ROD + CIRCLIP TO SPRING PLATFORM 70.0
EXPANSION HOLE TO DATUM SHOWN IN RED 72.5
FIXED POINT
WL
DATUM
57* E 57
72.5
120.1
MGB CLUTCH MASTER CYLINDER
BEST APPROXIMATE DISTANCE TO EXPANSION HOLE CORRESPONDS TO EDGE OF LIP SEAL TO WITHIN 0.5mm (BY EYE) GAUGED FROM SPRING BASE
REVISED 22/8/22
3/5/22
RM

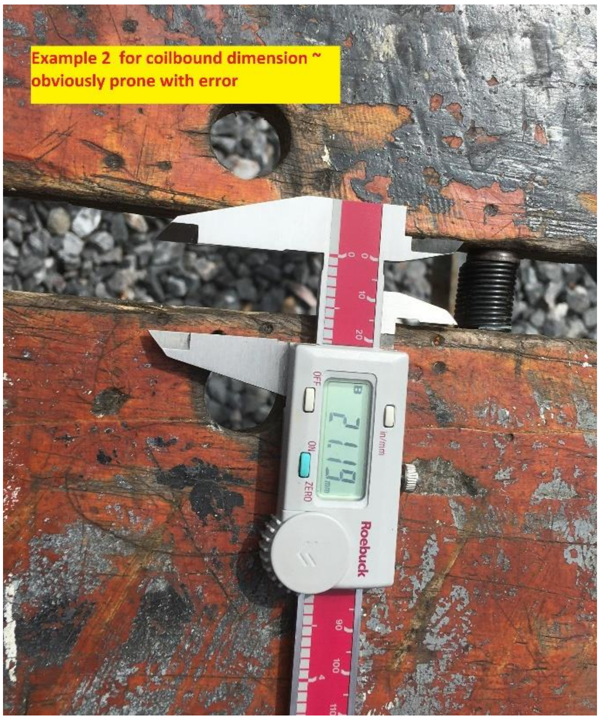

April 2022 failed item on left, October 2021 failed item in the middle. Item removed from metal can MC on far right

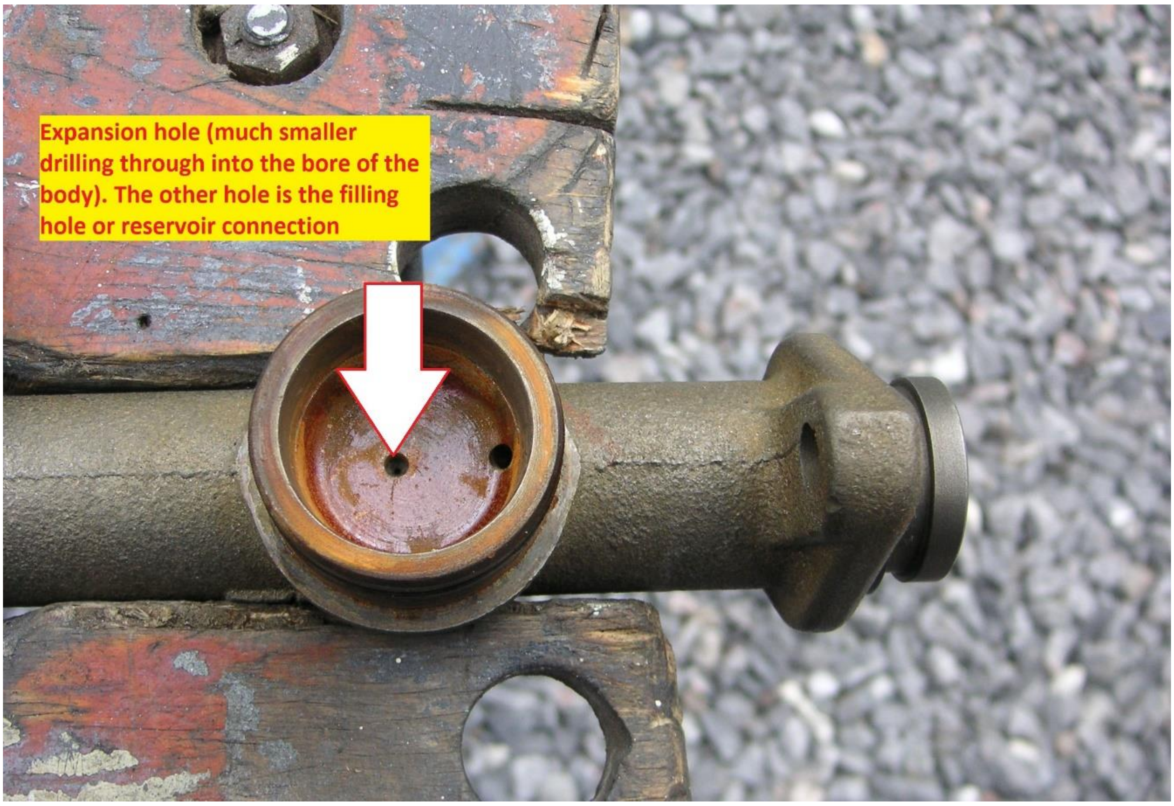

Set up to establish assembled spool length


Set up to determine maximum possible displacement


Reservoir bottom. The thin metal disc might perhaps be a baffle

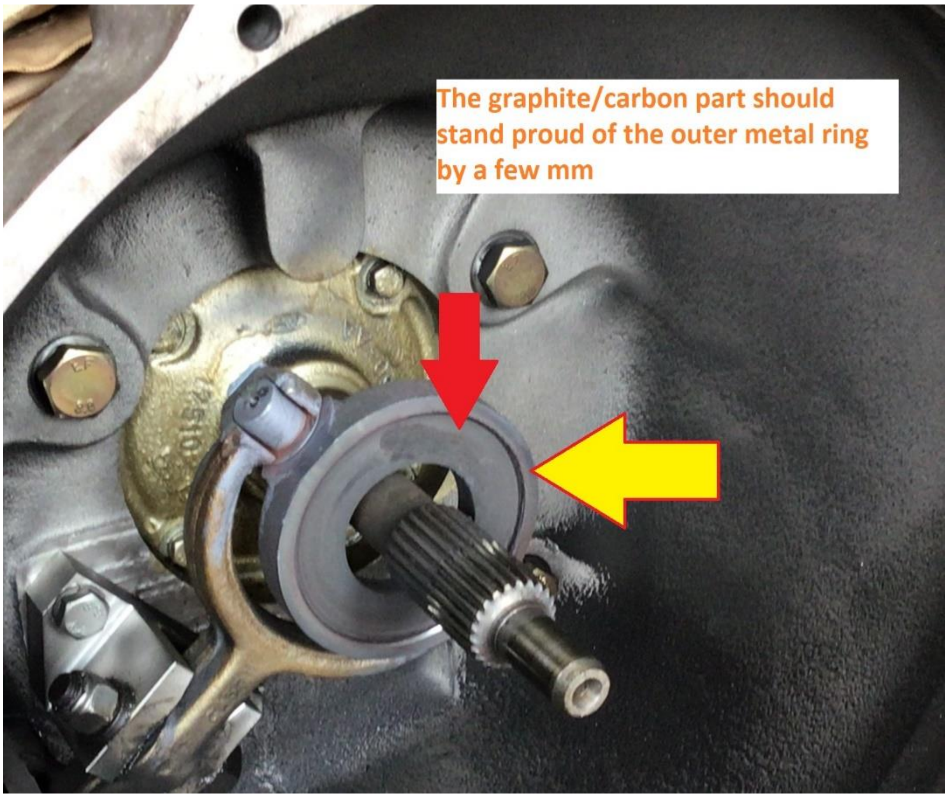

Example 1 coil bound dimension
Obviously prone with error
Roebuck
in/mm
18.27 mm
OFF
ON
ZERO

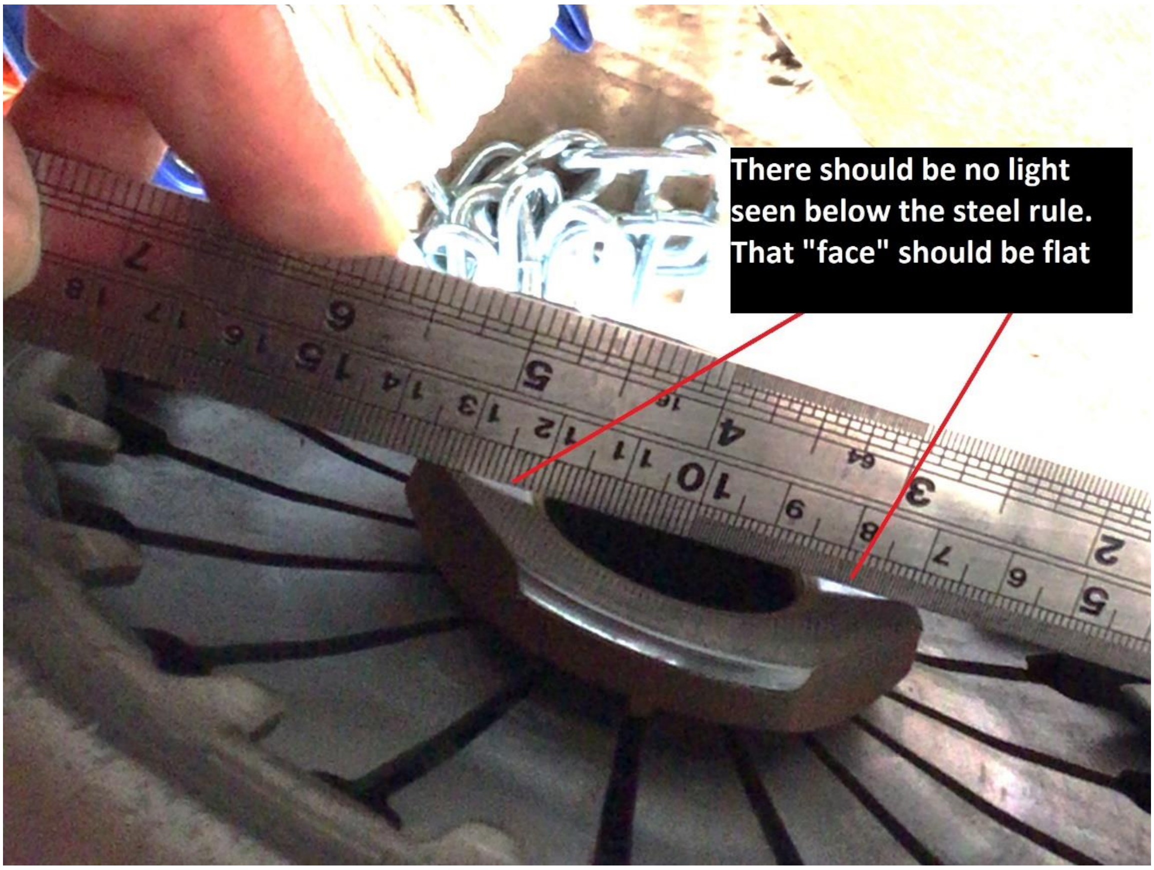

Example 2 for coilbound dimension ~
obviously prone with error
Roebuck
in/mm
21.19
OFF
ON
ZERO

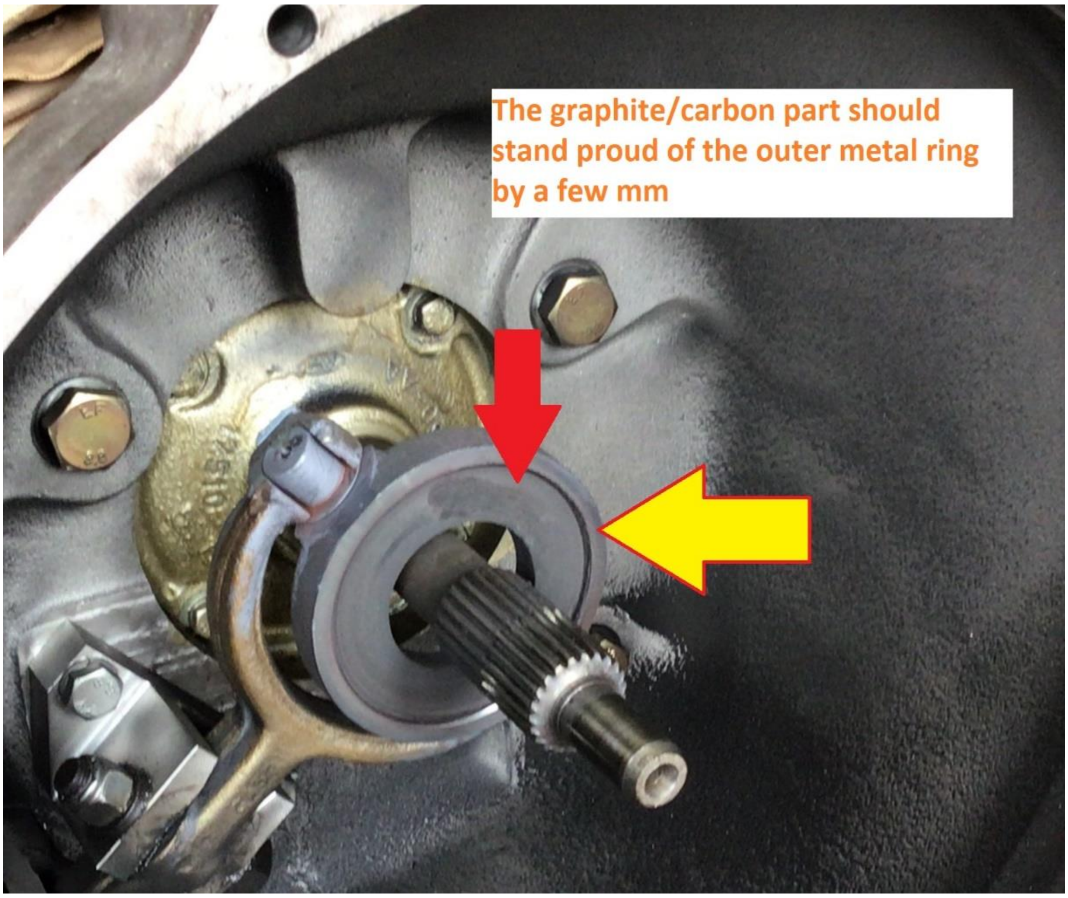

Expansion hole (much smaller
drilling through into the bore of the
body). The other hole is the filling
hole or reservoir connection


3 holes visible
With washer still in place


Aftermarket clutch master cylinder ~ general view


The graphite/carbon part should stand proud of the outer metal ring by a few mm


There should be no light seen below the steel rule. That "face" should be flat


The graphite/carbon part should stand proud of the outer metal ring by a few mm